

XXVI.—*Observations on the Natural History of the Water-Snail and Fish kept in a confined and limited portion of Water.* By ROBERT WARINGTON, Esq.

To the Editors of the Annals of Natural History.

GENTLEMEN,

The accompanying observations were thrown together with the intention of laying them before the Members of the Natural History Section of the British Association at their late Meeting in Belfast, but from sudden and unexpected business engagements I was prevented from attending, and thus, most unwillingly, obliged to forego the pleasure I had anticipated of discussing the details of the subject with so many of our leading practical naturalists as are generally assembled on such occasions. My time also was so much occupied as to prevent my copying them, in a readable form, before the Sections closed: should you, however, consider them worthy of a place in your valuable Journal, their insertion will much oblige.

Yours very truly,

ROBERT WARINGTON.

Apothecaries' Hall, Sept. 10, 1852.

My object in bringing the accompanying observations before the public is to endeavour to direct, more in detail than I have hitherto been able to do, the attention of naturalists, and those who take a delight and pleasure in the study of Nature's wonderful and glorious works, to a very simple means of easily investigating the habits and œconomy of all those numerous classes of animal and vegetable life that are capable of being brought within the limited precincts of the small water-cases I have elsewhere described*. And when I state that these observations have been made by one most ignorant on the subject of natural history, and a perfect tyro in this field of research, as the details of this communication will fully demonstrate; when I mention also that they have been made at leisure intervals of very short duration, snatched as an amusement and as opportunities occurred from the weightier matters of professional business;—I hope that it may encourage others to follow in the same most interesting course of investigation, when, aided by a little perseverance, they may ensure for themselves an abundant reward. The matured naturalist I am sure will agree with me in the argument, that if such observations can be made by those unacquainted with the subject, and without trouble or inconve-

* Quarterly Journal of the Chemical Society, vol. iii. p. 52; and Garden Companion for January 1852.

nience, it does offer a means of research which should develop some most interesting and important results, and that the same principle is capable of being extended to a much larger scale; a demonstration of which I believe will be very speedily exhibited. As regards the growth of the plants employed in these miniature ponds, I have already briefly treated in the 'Garden Companion' for January last, and shall therefore confine myself in the present communication to the two other members of the circle; and first—

The Water-Snail. This important element in all the cases where the removal of the decaying vegetable matter, or the growth of *Confervæ*, is necessary, to enable the generality of fish to live healthily, as must arise in most stagnant waters and ponds, offers to our consideration some very interesting phenomena. In commencing my experiments in the early part of 1849, I had employed the *Limnea stagnalis* for this purpose, but was soon obliged to substitute some less voracious inhabitant for my small domain, for I found that as it grew in size its appetite increased to an enormous extent, and the plants were punished most severely, the leaves of the *Vallisneria spiralis* being bitten quite through; and if the snails were in too large a number, the whole of the vegetation was rapidly removed; other varieties of the *Limnea* were consequently introduced at an early period, namely *L. auricularia* and *L. glutinosa*, as also *Physa fontinalis*, *Bithinia tentaculata*, *Planorbis corneus* and *P. carinata*. These last two varieties have been found highly serviceable, as from the con-
 nuated formation of their shell and small mouth, the fish cannot so readily get them out to feed upon. With the *L. auricularia* and *L. glutinosa* this is easily effected in consequence of the large aperture of their shell; and if the fish fails in his endeavours by a sudden attack to shake the snail out, he will attempt to suck it from its retreat, as is the case with the gold-fish; with the minnow (*Leuciscus Phoxinus*), however, it is different, as the smallness of its size renders this manœuvre impossible, unless the snail be very minute; it has recourse therefore to another and quite as efficient a means of obtaining its object, and I have seen these beautiful little fellows seize on their prey and shake it, as a terrier dog would a rat, between a piece of the rock-work and the glass, until they have broken its thin and delicate shell to pieces, and having effected this to their satisfaction quietly consume their victim.

It will be seen from these facts, that the snails will require to be renewed at intervals, particularly as I have previously shown that the increase of the snail by its eggs, which are deposited in very large quantities, is entirely prevented from the fish consuming them the instant they exhibit signs of locomotion.

These water-snails have the extraordinary power of moving along the surface of the water with great rapidity with their shells downward, the foot being attached as it were to the atmospheric air. The *Planorbis* also can fix itself, without any apparent means of attachment, by its side to the flat surface of the glass, and will remain thus for several days.

In watching the movements of the *Limnææ*, I was for some time under the impression that they had a power of swimming or sustaining themselves in the water, as they would rise from the bottom of the pond, a portion of the rock-work, or a leaf of the plants, and float for a considerable period, nearly out of their shells, without any apparent attachment, and by the contortions and gyrations of their body and shell, move some little distance, in a horizontal direction, from the point which they had left. On more carefully watching this phenomenon, however, I found they were attached by a thread or web, which was so transparent as to be altogether invisible, and which they could elongate in a similar way to the spider; they also possessed the power of returning upon this thread by gathering it up as it were, and thus drawing themselves back to the point which they had quitted. These facts were clearly proved in the following manner:—A *Limnæa stagnalis* had glided its way along a young and short leaf of the *Vallisneria* which terminated below the surface of the water, and having reached the extremity launched itself off from it; after moving about with a sort of swimming or rolling motion in a horizontal direction for some time it lowered itself gradually, and in effecting this the long flexible leaf of the *Vallisneria* was bent with an undulating motion, corresponding exactly with every movement of the snail, clearly showing that it had a firm attachment to the extremity of the leaf. On another occasion a *L. glutinosa* gradually rose from the surface of a piece of submersed rock, and when at the distance of about 3 or 4 inches from it stayed its progress, floating about in a circumscribed horizontal direction for some time; at last it rose suddenly and rapidly to the surface, evidently from the rupture of its thread of attachment. The most convincing proof, however, of this fact that I can perhaps adduce, and one that I have often repeated with all the before-mentioned *Limnææ*, is that when the snail has been some inches distant from the supposed point of attachment, a rod or stick has been carefully introduced, and slowly drawn on one side between them in a horizontal direction, and by this means the snail can be made to undulate to and fro, obeying exactly the movement of the rod: this requires to be done very gently, as, if too much force is used, the web is broken, and the snail rises rapidly to the surface.

The next subject of interest which I wish to call attention to is—

The Stickleback, *Gasterosteus leurus*. This most beautiful little creature has afforded a subject for much interesting observation for some time past, and I fear that what I have to offer will prove very much a repetition of what has already been published on the subject. As however the proceedings and observations of those who dare not rank themselves in the class of naturalists, sometimes from their want of knowledge cause circumstances to arise which would not otherwise occur, so in the present case my failures through my own ignorance may develop some new points in the œconomy of these small fry. Mr. Edwards of Shoreditch, whose London garden pond has afforded much interesting matter to many microscopists, informs me, in a note dated August 27, 1852, that it is about fourteen years since he first noticed the fact of the stickleback building a nest, guarding the spawn and defending the young ones: no publication, however, of these observations seems to have taken place. Since this period, the facts have been published by M. Coste in France in 1847, and quite lately by Mr. Kinahan*, in a paper laid before the Dublin Natural History Society.

My observations in the miniature ponds commenced in May 1851, when, having received from a friend at Mitcham several of these little fish, male and female, the latter being full of spawn, they were introduced to their new abode. A curious scene followed: the male fish immediately took up certain positions, the strongest apparently having the first choice, which they maintained against all intruders, and a species of border warfare was continually maintained across the proscribed boundaries of each, and although at times driven out by a fierce attack from a stronger fish, yet, immediately the battle had ceased, they returned to their previous position, which they defended most vigorously. These battles were at times most desperate, for these puny combatants would fasten tight on each other for several seconds, tumbling over and over, until their strength appeared completely exhausted. If there were more fish present than there were positions for, they fared most grievously, being driven altogether into one corner of the pond, and from which they ventured forth only to be driven back again on all sides, where they were continually exposed to the attacks of their companions.

The day after they had been placed in their new domain, the strongest of the male fish was observed most busily employed gathering small ligneous fibres from different parts of the pond,

* Zoologist for July 1852.

and carrying them in its mouth to one particular spot, where he appeared to force them into the sand and gravel with his nose. Being perfectly unacquainted at the time with the fact of this little creature building a nest, I watched him more attentively. He had selected a spot behind a piece of rock-work, almost hidden from view at the front of the case and towards the room; but on looking down from the top of the water I could perceive that he had already constructed a small hole as round as a ring and with a good broad margin to it, formed of the materials he had been so industriously collecting, and on which he appeared to have placed numerous particles of sand and small pebbles. This spot he guarded with the utmost jealousy, continually starting forth from his position and attacking the other fish with most extraordinary fury. The desperate ferocity with which this fish attacked the others, and the continued turmoil the whole pond was kept in, determined me to do a most absurd act, which I instantly afterwards regretted, and my want of knowledge of the subject at the time had prevented my foreseeing, namely to remove this fish from the pond. I therefore caught it in a small muslin net, and without the slightest trouble, as he attacked the net the instant it was introduced. But what was the consequence? No sooner was he removed from the water than the other fish darted to the spot he had been protecting, pulled forth a mass of eggs which had been deposited there, and which I had not previously seen, tore it to pieces among them, and devoured it before I had time even to shake my prisoner out of his confinement; however, it taught me a fact in natural history, and it may perhaps be novel to others. So ended my experience of 1851.

Now I think it will be evident from what I have stated that these eggs must have been deposited by the female fish, and the nest made around them afterwards; and this I think was also the case with the fish experimented on this year by my friend Mr. Gratton, who had a fine brood of young sticklebacks hatched after fourteen or fifteen days, the nest being formed immediately after the introduction of the fish.

The appearance of the male fish during this spawning period is beautiful beyond description. The eye is of the most splendid green colour, having a perfectly metallic lustre like the green feathers of some species of humming-bird. The throat and belly are of a bright crimson, the back of an ashy green, and the whole fish appears as though it were somewhat translucent and glowed with an internal incandescence: his ferocity during this period is extraordinary. How so small a creature can bear up so long under such a state of apparent excitement appears marvellous. Later in the year the colours slightly change, the back becomes

more of a green tint; the throat and belly of a paler red, and all the glowing appearance subsides. The female fish is of a brown colour on the back, the eye also brown and the belly white.

I now pass on to the present year, when I had the pleasure of seeing the nest built from the very commencement and through all its stages. The place selected for the nest was the bare flat top of a piece of oolite where it formed a right angle by resting against the glass partition which separated two of these ponds, in one of which were kept four minnows and two small eels, and in the second the sticklebacks which form the subject of this observation. In this the male fish commenced gradually to deposit and accumulate his materials. I will endeavour to give in detail the exact description of his proceedings while I had the opportunity of watching him, avoiding as much as possible the repetition of his operations; for as each loose fibre or small piece of material was brought singly to the chosen spot, the same routine would be gone through over and over again:—Now he arrives with a large fibre in his mouth, deposits it, rearranges the whole of the materials, already accumulated, with his mouth, removing one fibre to this place and another to that, and departs on his search for more. Now he returns carrying a small piece of gravel, which is carefully placed on part of the fibres as it were to keep them down; he then draws himself slowly over the whole and is off again. Now he brings another fibre, which he dubs in with his snout so as to make it interlace with the others; then he attempts to interlace in the same way the fibrous rootlet of a Lemna which is growing above his head, but which the instant he thinks he has fastened and loosens his hold of, rises again by its expanded lobe to the surface; this fibre appears to be well fitted for his purpose, for he repeats his attempts to fix it among his gleanings over and over again. Now he is busy making a circular hole in the middle of the accumulated materials with his snout; a piece of the fibre is next taken out from the mass, projected from his mouth, watched as it falls very slowly through the water; then, as it proves too light for his purpose, it is again seized, carried to some distance, and projected away, and he is off to rearrange the remainder, carefully tucking in the ends with his snout; he then draws himself slowly across the whole and is off again. Now he catches a sight of the female fish, pursues her with great rapidity, seizes her by the tail and by the lateral spine, but she escapes his grasp and conceals herself behind the rock-work. Again he conveys more material to the nest, and the next journey is again laden with another small piece of gravel; the whole is then slightly shaken, then compressed, and he is off again; thus he conveys without cessation decayed rootlets, gravel, sand, and whatever material he

can find that will answer his purpose. But I must observe that their specific gravity is continually tested : thus, having found what appears a suitable fibre, it is carried a little way, then projected to a short distance from his mouth and watched as it falls ; if it falls rapidly, it is again seized and carried direct to the nest ; if more slowly, it is tried again in the same manner ; and if it then proves too light, it is abandoned altogether and another selected. If a piece is found better fitted for his structure than what he has already obtained, it is rapidly conveyed to the spot ; much alteration in the arrangement of the materials takes place, so as apparently to dispose of the new prize to the best advantage, and it is only after continued and indefatigable perseverance that he succeeds in rearranging them to his wishes. If there should be any strong fibre which he has a difficulty in causing to remain in the position he requires, a small quantity of sand is brought in his mouth and adroitly placed on the top of it to keep it down ; if this does not effect the purpose desired so as to please him, the refractory piece is taken out and rejected altogether. At times he hangs or hovers close over the surface of the nest and throws his whole body into a curious and rapid vibratory motion, by which he causes a rapid current of water to be projected on the materials as though it were to prove their stability ; and when this operation is performed, the lighter particles and light mud are as it were fanned or winnowed out by the generated current, and may be seen floating away : this operation will also explain the reason for testing the gravity of the materials before they are used. Another very curious operation is the action of drawing his body slowly over the surface of the materials which form the nest. I believe that at this time he excretes a glutinous matter which acts as a species of cement, and tends to keep the materials together, at the same time that the pressure of his body may render them more compact. Or it may be that the whole surface of the nest is by this action charged with the milt, and thus the impregnation of the eggs more perfectly ensured, as precisely the same motion is employed after the eggs are deposited, and from the appearance of the fish it seems to be attended with pleasurable sensations. These two last-described operations are very frequently repeated.

If during this time any other male fish makes his appearance, he is chased with the utmost ferocity and driven to conceal himself in any cranny which he can find ; should, however, another fish be also building, desperate battles ensue whenever they approach each other's position, or chance to meet while collecting their materials.

The whole time occupied in accumulating these materials for the nest was about four hours, during which interval a goodly quantity had been obtained ; and a small opening appeared to be

carefully constructed near each end of the mass, the use of which will be now explained. All having been apparently arranged for the female fish to spawn, and the operations of fanning out the light particles, the improving their order, the dibbing in the ends, the loading them with additional sand, and the consolidation of them as described fully effected, and the whole reviewed carefully for several days in succession, as it were awaiting the coming of the female, on her appearance the following curious scene ensued. The female fish came out of her hiding-place, her attention being fixed apparently on the nest, when immediately the male became as it were mad with delight; he darted round her in every direction, then to his accumulated materials, slightly adjusted them, fanned them, and then back again in an instant; this was repeated several times; as she did not advance to the nest, he endeavoured to push her in that direction with his snout; this not succeeding, he took her by the tail and by the side spine and tried to pull her to the spot, then back to the nest, and having examined the two small openings alluded to, he thrust his nose in at the lower and gradually drew himself under the whole of the materials, making his exit at the opposite one, as though to prove to her that everything was prepared for her spawning. These manœuvres, however, failed in their purpose; she examined the nest several times; but the appearance of the minnows, &c. moving about on the other side of the glass partition against which the nest had been formed, I believe deterred her from depositing her eggs there, and she afterwards spawned elsewhere. The nest which had cost so much trouble was ultimately abandoned and neglected, and was gradually dispersed by the snails.

There are several other interesting particulars regarding the habits of the several fish, &c., which I have had the opportunity of experimenting with, and which may form the subject of some future memoranda. I would merely remark in conclusion, that I have after many difficulties and failures succeeded in keeping sea-water perfectly clear for upwards of six months, and that I have for the last five weeks had several sea-anemones living in it which at present appear extremely healthy, and the water has not been disturbed for the last fourteen days. My great difficulty in the midst of London has been to obtain materials to work with.

XXVII.—*Description of a new species of Wart Pig from the Camaroons.* By J. E. GRAY, Ph.D., V.P.Z.S.

THE Zoological Society has recently received, from the Camaroon River in West Africa, a new, and, for the family, a very beautiful species of Pig, which appears to be undescribed. It belongs to